

Report on Inspections of Household Freezers

Prepared for
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A handwritten signature in black ink, appearing to read "JAM Boulet", with a horizontal line underneath.

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Observations

On December 19, 2016, at the request of Mr. Gene Hallworth, attorney, the author inspected and photographed a freezer at the home of Ms. Gracie Hunt Craun at 219 Meadowlark Drive, Pulaski, Tennessee. Ms. Craun indicated that the inspected freezer was a replacement for one that had been defective. Figure 1 is a photograph of the freezer.



Fig. 1 Replacement Freeze at Craun Residence

Figure 2 is a close-up view of the manufacturer's emblem noted in Figure 1.



Fig. 2 Manufacturer's Emblem

Figure 3 is a photograph of the information sticker on the inside of the freezer. The model number is clearly visible in the figure.

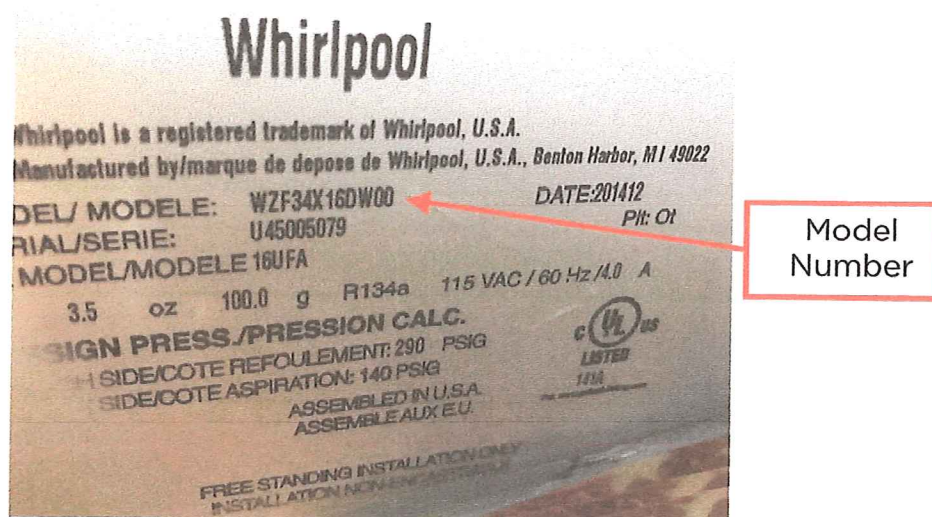


Fig. 3 Information Sticker

Figure 4 shows a ceiling fan that Ms. Craun said was installed on the same day as the freezer that leaked and has worked normally ever since.



Fig. 4 Ceiling Fan at Craun Residence

While at the Craun residence, the author also measured the inside and outside dimensions of the home and noted the location of the return air for the HVAC system.

Later on December 19, 2017, again at Mr. Hallworth's request, the author inspected the freezer that had originally been placed in the Craun residence. This inspection occurred at Lowe's Home Improvement, 1734 North Main Street, Shelbyville, Tennessee. The inspection was witnessed by several people including Mr. Hallworth, an attorney for Whirlpool, another expert and a few employees of Lowe's. During the inspection, the fibrous panel at the bottom, rear of the freezer was removed to expose the compartment containing the freezer's compressor. After photographs were taken and some measurements recorded, the compressor was removed from the freezer and a Lowe's employee cut the charge tube to separate it from the compressor. The oil remaining inside the compressor was then poured out (through the hole where the charge tube had been connected) and collected in a graduated cylinder. That oil was then transferred to a glass jar and sealed inside via a screw-on lid with a rubber gasket. As the group departed the premises, the compressor, the charge tube and the jar containing the oil were stowed in the trunk of my vehicle. Photographs and observations related to this inspection follow.

Figures 5 and 6 show the back and side of the freezer prior to inspection.

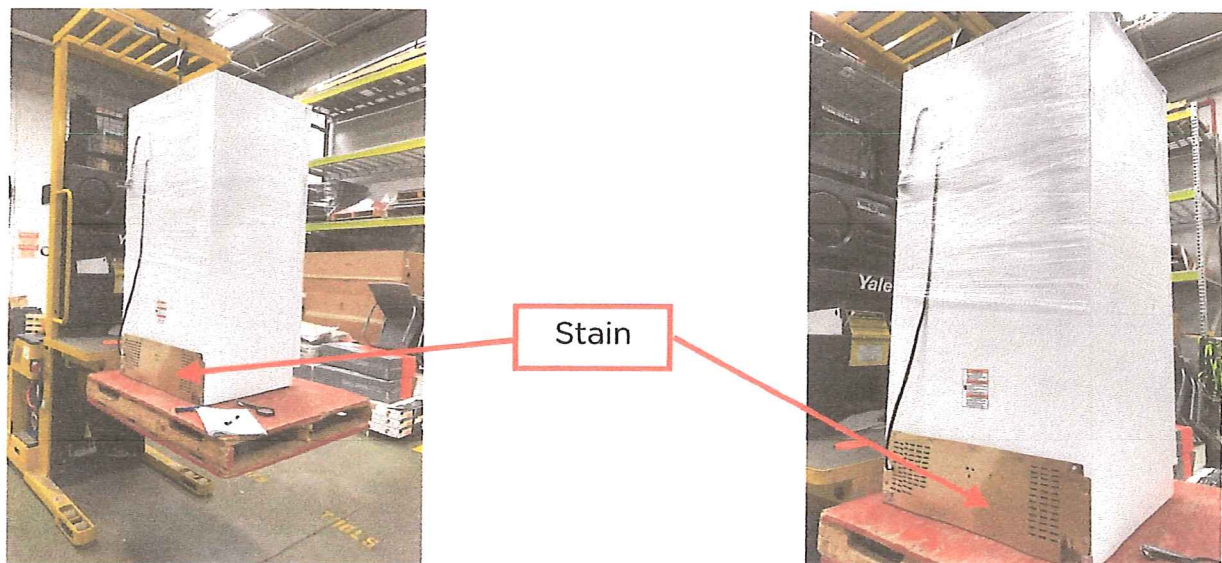


Fig. 5, 6 Freezer at Lowe's, Prior to Inspection

Note the stain on the fibrous panel, which covers the compartment housing the compressor. Figures 7 and 8 show the front of the freezer prior to inspection and the interior of the freezer, respectively.

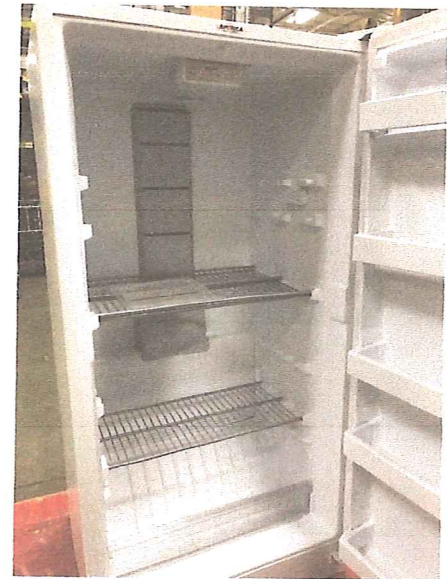
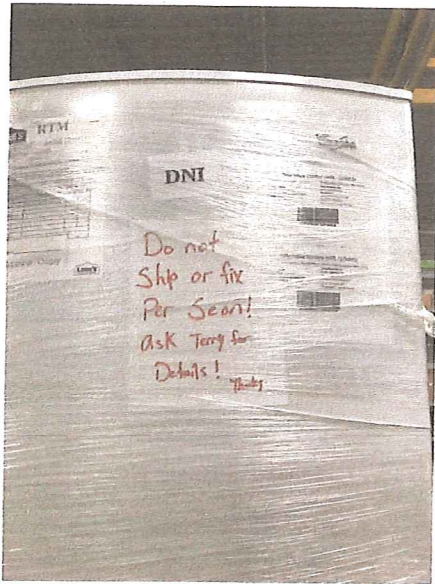


Fig. 7, 8 Front and Interior of Freezer at Lowe's

Figure 9 shows the information sticker for the freezer at Lowe's, showing that the model number matches that of the replacement freezer shown in Figure 3.

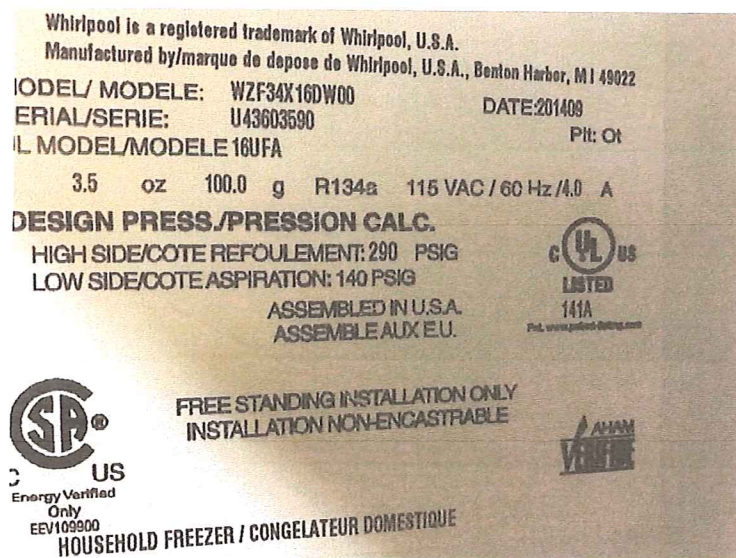


Fig. 9 Information Sticker on Freezer at Lowe's

Figure 10 shows the lower rear of the freezer, giving a clear view of the extent of the stain on the fibrous panel. As will be seen in subsequent figures, the compressor is housed immediately in front of the stained area.

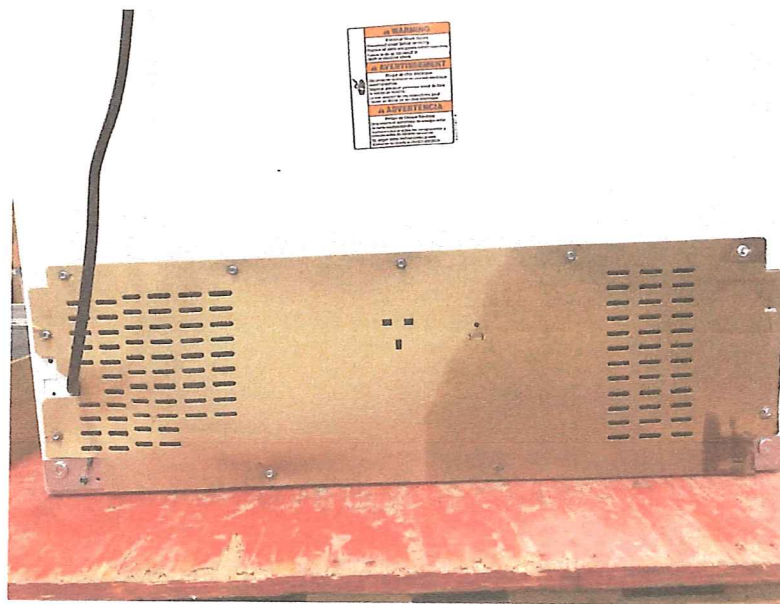


Fig. 10 Panel Covering Compartment Containing Compressor

Figure 11 shows the compressor after removal of the fibrous panel. The location of the compressor is immediately in front of the stained area on the fibrous panel that covered the compartment. Note the position of the charge tube. The leak probably originated at a crack in the noted solder joint in the charge tube.



Fig. 11 Compressor Prior to Removal from Freezer

Relative to the stained area on the fibrous panel shown in Figure 10, the soldered joint is approximately centered horizontally.

Figure 12 is a closer view of the charge tube region shown in Figure 11.



Figure 13 shows the information sticker on the side of the compressor. The point where the charge tube enters the compressor's housing is noted.

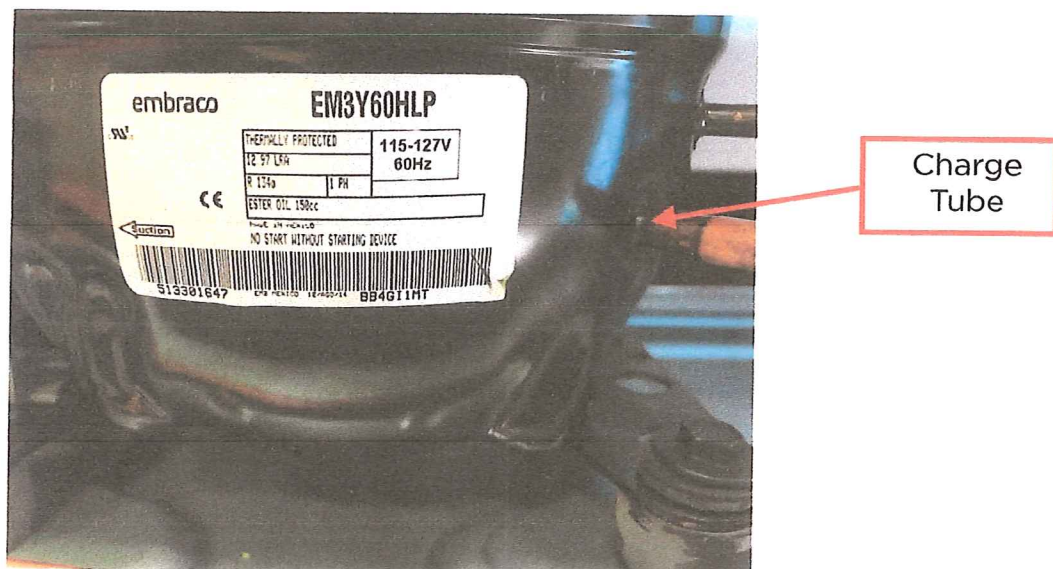


Fig. 13 Compressor's Information Sticker

Figure 14 shows cracks in the solder joint, through which the refrigerant probably leaked into the room where the freezer was initially installed.

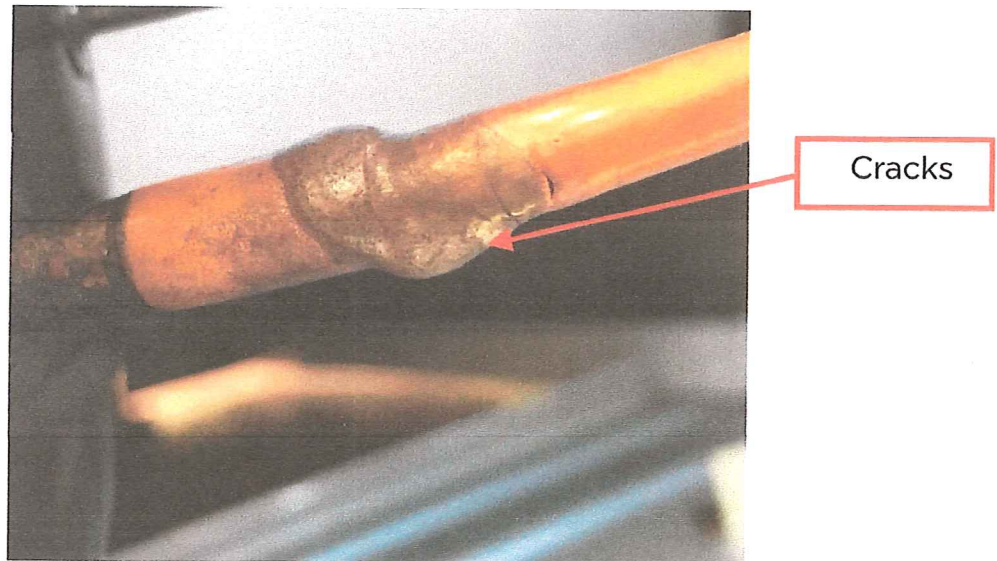


Fig. 14 Cracks in Solder Joint

Figure 15 shows a measurement indicating that when the fibrous panel was in place, the distance between the panel and the crimped end of the charge tube was about 3/4 inch. Measurement of the deflection of the fibrous panel due to pushing in by hand near the crimped end of the charge tube indicated that contact between the panel and the charge tube was highly unlikely. This implies that the cracks in the solder joint of the charge tube were most likely not caused by bending of the tube due to contact with the panel after the panel was installed.

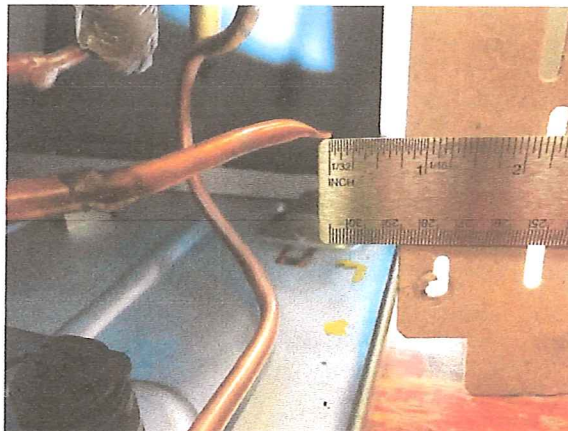


Fig. 15 Distance between Charge Tube's End and Fibrous Panel

Figure 16 shows the compressor after the charge tube was cut away and after the compressor was removed from the freezer.

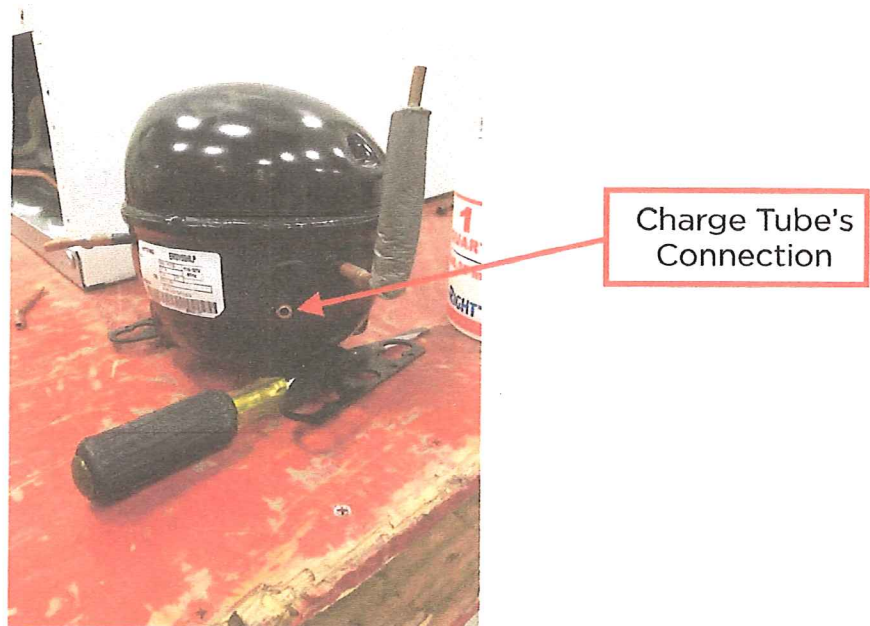


Fig. 16 Compressor after Being Removed from Freezer

Figure 17 shows oil being poured out of the compressor through the hole left by cutting away the charge tube.



Fig. 17 Pouring Oil from Compressor

Figure 18 shows that the volume of oil poured from the compressor was approximately 45 milliliters.



Fig. 18 Oil from Compressor

On February 13, 2017, in the machine shop of the Mechanical, Aerospace and Biomedical Engineering (MABE) department at the University of Tennessee, Knoxville (UTK), the author met with a machinist who used a cutting tool to remove the top from the compressor's housing and then poured the remaining oil into a measuring cup. The oil was then transferred to a glass jar and sealed inside via screw-on lid with a rubber gasket.

Figure 19 shows the compressor clamped to a table in the MABE machine shop.



Fig. 19 Compressor Clamped to Table

Figure 20 shows the compressor's information sticker.

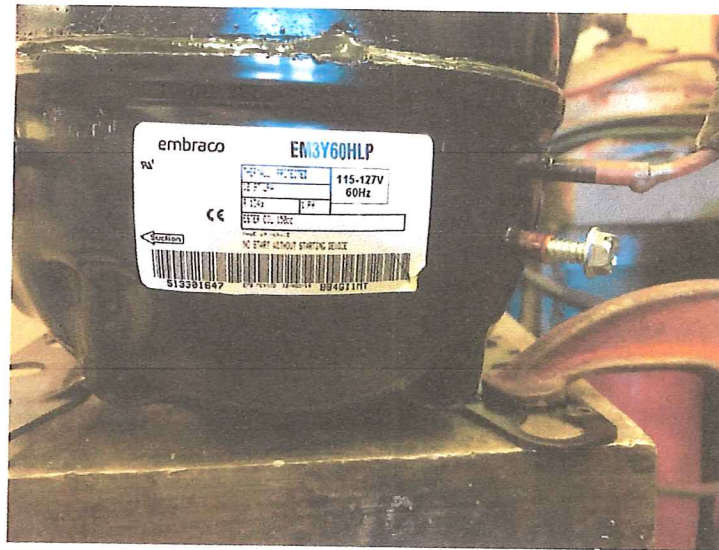


Fig. 20 Compressor's Information Sticker

Figure 21 shows the cutting tool used to open the compressor's housing.



Fig. 21 Cutting Tool

The cutting operation and subsequent pouring of the remaining oil were captured in video files. The volume of oil recovered was less than one fluid ounce (30 milliliters).

On February 20, 2017, again in the MABE machine stop at UTK, the author met with an electrician who checked the compressor's electric motor with a megohmmeter and volt meter. Readings across the various terminals and ground (common) indicated that the insulation and windings were normal, which implies that the motor was undamaged. This further implies that when the mixture of oil and refrigerant leaked from the system, the motor was protected from overheating by an internal switch activated by a sensor, probably one that measured either the temperature of the motor or the pressure in the fluid of the system.

Conclusions

1. Cracks in the solder joint of the charge tube, such as those seen in Figure 14, would have allowed a mixture of oil and refrigerant (R-134a) to leak from the compressor into the room where the freezer was initially installed.
2. The position of the stain on the fibrous panel covering the compartment holding the compressor is consistent with leaking in the vicinity of the compressor's charge tube.
3. Due to the nature of the refrigerant, any mixture that leaked from the compressor would have expanded into the room in which the freezer sat and would have been recirculated to the entire Craun residence via its HVAC system.
4. Absence of refrigerant in the compressor did not cause the motor to run continuously until it was damaged.
5. Less than 75 milliliters of oil (45 ml at Lowe's, less than 30 ml at the machine shop) was recovered from the compressor. Hence, the total volume of oil remaining in the compressor was less than half of the total oil in the system as indicated by the compressor's information sticker in Figures 13 and 20 (150 cc = 150 milliliters).